

Claims

- [c1] 1. A robot manipulated roll form hem tool, the robot having an arm with a receptacle on one end, the hem tool comprising:
- an end effector adapter that is adapted to be received in the receptacle on the end of the robot arm;
 - a linkage comprising a bracket extending from the end effector, a tool support member, and two links that connect the bracket and the tool support member together as a four bar linkage;
 - a first roller disposed on the tool support member with an axis of rotation that is at a first angular orientation relative to the tool support member;
 - a second roller disposed on the tool support member with an axis of rotation at a second angular orientation relative to the tool support member that is different than the first angular orientation; and
 - a force transducer operatively engaging the tool support member to limit force applied by the robot arm to the rollers through the tool support member.
- [c2] 2. The hem tool of claim 1 wherein the tool support member is supported by the linkage for limited move-

ment relative to the end effector adapter and is biased by the force transducer into an extended position, wherein upon engagement by one of the rollers with a workpiece to form a hem on the workpiece the force applied to the workpiece is limited by the force transducer.

[c3] 3. The hem tool of claim 1 wherein a third roller is provided on the tool support member with an axis of rotation that is at a third angular orientation that is different than the first and second angular orientations.

[c4] 4. The hem tool of claim 1 wherein a fourth roller is provided on the tool support member with an axis of rotation that is at a fourth angular orientation that is different than the first, second, and third angular orientations relative to the tool support member.

[c5] 5. The hem tool of claim 1 wherein one of the rollers applies a force to the force transducer that flexes in a linear direction as the roller engages a workpiece.

[c6] 6. The hem tool of claim 1 wherein the rollers are disposed generally in alignment with the end effector adapter and the force transducer so that force is applied to a hem flange to be formed on a workpiece in a direction that is normal to the axis of rotation of the rollers.

[c7] 7. A roll form hem tool, comprising:

a linkage comprising a bracket, a tool support arm having a back end and a distal end, two links that connect the bracket and the back end together as a four bar linkage with the tool support arm being moveable relative to the bracket, and a force transducer engaging the tool support arm and the bracket to limit force applied by the tool support arm;

a pre-hem roller disposed on the tool support arm at a first angular orientation relative to the tool support arm; and

a final hem roller disposed on the tool support arm at a second angular orientation relative to the tool support arm that is different than the first angular orientation, wherein the tool may use the pre-hem roller to form a pre-hem bending operation and use the final hem roller to form a final hemming operation.

[c8] 8. The hem tool of claim 7 wherein the tool support arm is supported by the linkage for limited movement relative to the bracket in a linear flexing action, wherein upon engagement by one of the rollers with a workpiece to form a hem on the workpiece the force applied to the workpiece is limited by the force transducer.

[c9] 9. The hem tool of claim 7 wherein a second final hemming roller is provided on the tool support arm.

- [c10] 10. The hem tool of claim 7 wherein a second pre-hem roller is provided on the tool support arm at a different angular orientation relative to the tool support arm than the first angular orientation.
- [c11] 11. The hem tool of claim 7 wherein the linkage transfers a spring force from the force transducer in a linear direction to one of the rollers as the roller engages a workpiece.
- [c12] 12. The hem tool of claim 7 wherein the pre-hem roller and the final hemming roller are disposed generally in alignment with the force transducer so that a force applied to a workpiece by either the pre-hem roller or the final hemming roller in a direction normal to an axis of rotation of one of the rollers is transferred in a linear direction to the force transducer.